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"Functional localities: an integrated spatial approach towards health care locality definition"

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Abstract This paper demonstrates a spatial approach towards the definition of localities for health care planning. Recent international decentralisation of health care provision, and more specifically devolution within the United Kingdom, emphasises the need to develop a geographical focus in the delimitation of local structures for health care planning. Geographers, but most especially those applying Geographical Information Science (GIS) techniques, have made enormous contributions in this field and more generally in research related to health services. This paper considers some of these previous approaches and moves on in the light of new technologies, and more importantly the availability of appropriate data, to create localities that reflect dynamic spaces of social interaction, administration and policy. The paper's focus is placed on the importance of flow data that reflects the spatial interaction between services and the population. This data, divided into three sub-groups of administration, education and health, allows us to identify the population's allegiance to place and ultimately create spatially bounded functional localities that reflect this. Whilst the approach is largely technology driven, it also incorporates the expertise of local health care professionals thus recognising the importance of collaboration and multi-sectoral engagement. Although this combined approach impacted upon the way in which the final localities were defined, crucially it enabled us to incorporate features of both rigorous spatial analysis and a wealth of local knowledge.

Keywords Locality · Health care planning · GIS · Health geography · Spatial interaction

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Introduction

Decentralisation and devolution have become commonplace in health care delivery, most especially at the primary care level. The European Working Group on Quality in Family Practice identified team building in a locality setting as one of the major targets for the development of effective primary care (Kvamme, Olesen, & Samuelsson 2001). In 1991, the World Health Organisation (WHO) suggested the creation of supportive environments for health that *"encompass where people live, their local community, their* *home, where they work and play, including people's access to resources for health and opportunities for empowerment''* (WHO, 1991). Many countries have embraced this ideology. For example, the recent primary care strategy in Ireland suggested a geographic focus to the provision of care *''to strengthen the capacity of the primary care team to adopt population health approaches to service provision''* (2001, p. 8). Recent strategies in New Zealand (2001), Hungary (Ferguson & Irvine, 2003), Canada (2001) and Australia (2001) have all adopted approaches that involve the provision of care to defined populations.

In the United Kingdom the issues of decentralisation and devolution are paramount to locality planning in all policy arenas, and particularly evident in the National Health Service (NHS). Recent trends towards *decentralisation* in the NHS have been influenced by wider political and social policies, such as devolution in Scotland, Wales and to a certain extent Northern Ireland. The evolution of primary care led purchasing, with the market style approach of fundholding and the development of Primary Care Groups and Trusts, has developed an increased impetus towards a primary care led NHS and the provision of such care at the locality level (Butler and Roland, 1998; Chisholm, 1998 and Iliffe and Munro, 2000). This shift in resources from the secondary sector to primary care ensures the expansion of intermediate care at the primary level and decision making closer to the 'consumer'. According to Craig, McGregor, Drummond, Fischbacher, & Iliffe (2002) however tension remains between the core and periphery and should be addressed so that the benefits of this responsibility transfer will match local needs. The advances made towards such locality planning, and more specifically the geographer's role in the spatial delimitation of localities, is crucial to understanding the meaning of locality and the importance of this spatial structure.

The locality debate

The 'locality' debate has been raging in academia for many years having emerged in geography in the 1980s, largely as a result of the ESRC's 'Changing Urban and Regional System' initiative. This paper does not strive to create the ultimate definition, or indeed add to the theoretical debate. Instead we will focus on the practical definition of a locality and the mapping aspects associated with it. The term 'locality', though itself susceptible to multiple interpretations, is preferred here, as reference to other terms such as 'community' are vastly contentious notions value laden with sociological interpretations (Cooke, 1986 and Hillery, 1995). Norheim (1999) suggests that people use the word community in a romantic sense thus *''clouding the complexity of dynamics operating within and between groups''*. In contrast others feel that the term locality does little to reduce the tension around such constructs, with Duncan and Savage (1991) stating that the idea of a locality is *''confusing, even irritating''*. Within health care planning the term locality is partially seen as ''untainted and neutral'' as ''*the word community had attracted the suspicion of being fresh centrist sheep's clothing for centrist wolves seeking to devise fresh ways of closing cottage hospitals''* (Day, 1990, p. 30). Despite the fact that the term locality may be more neutral, it is recognised that a large gap exists between the acknowledgement of the sociological construct of localities and the identification of such by any practical means for the organisation of service delivery (Kivell, Turton, & Dawson, 1990). Although it has been stated in public policy that localities should be used for the delivery of services (DoH, 1997 and DoH, 2006) often times administrative units are taken as being representative of such areas, thus neglecting the reality of networks and flows. The difficulty in actually defining the boundaries of localities is a direct result of the fact that they are not bounded, static entities but dynamic spaces of social interaction, family ties, administration, policy and government. According to Fincher these social relations emanate ''*from experience of the local state, the local labour market, or any other 'sphere' of material life''* (p. 676, 1989). In the context of this research a locality is seen as a perceived sociological construct in which people live their everyday lives and defined as where people live, work, worship, attend their GP or go to school. The aim of this paper is to present a methodology that was used to help define geographical localities for the purpose of health service delivery and management in a health and social services board in Northern Ireland.

Defining localities for health care planning

The most recent locality focus in the NHS has been the publication of the White Paper "Our Lives, Our Health" in January 2006 which focuses on change being driven in localities and not through central bureaucracy (Department of Health, 2006). A knowledge of local areas and their socioeconomic characteristics is necessary to identify health needs and target services (Odoi et al., 2005), but how do we identify these local areas? A previous paper by the authors (Shortt, Moore, Coombes, & Wymer, 2005) highlighted several pioneering attempts at locality planning in the NHS, including Exeter Health Authority (King & Court, 1984 and Court & Phillips, 1985) West Sussex (Taket & Curtis, 1989) and the Pimlico Patch Committee (Dunford & Hughes, 1988). However, little attention has focussed on how we actually try to bound these sociological constructs when we consider that, by their very nature, localities will be defined as different spaces representing different interpretations of these constructs. As such what should we consider in order to strike a balance between the planning and service delivery arrangements within these areas and the need to define sensible groupings of populations, areas and social networks?

For reasons relating primarily to difficulties and inconvenience in the collection and analysis of data, health service practitioners and planners have long relied upon existing administrative units when defining artificial localities. These units may not necessarily reflect meaningful social networks or groupings and according to Campari (1996) they are artefacts of administrative systems. Taking a more encompassing approach in North Staffordshire, Kivell et al. (1990) retrieved information regarding the spatial organisation of various services, including community health and social services, policing areas and primary school catchments. The amalgamation of health service boundaries with those reflecting other local services highlights the importance of co-terminosity in defining health localities. Taket and Curtis' (1989) exploration of locality planning in the Tower Hamlets area of London represented an approach of 'realism and compromise' and emphasised the importance of collaboration between the local authority and the researchers. A similar approach by Bullen, Moon and Jones (1993) in West Sussex represented a shift in the recognition of the importance of geography at the policy level. The combined approach by the health authority and the authors (members of the Health Information Research Service) provided a multi-disciplinary means of defining localities, from both an academic and administrative perspective. The process adopted here used two approaches; 'constrained' and 'unconstrained', with the results of the 'constrained' approach being subject to the specific recommendations of the health authority. These consultation processes acknowledge the overriding importance of policy and bureaucracy which Balogh (1996) refers to as *'potentially very complex'* in the organisation of social space for health care delivery.

In our study locality definition is seen as a form of functional regionalisation that can be described as the process of demarcating boundaries for any purpose including administration, health care and Parliamentary Elections. We are concerned with measuring interaction between areas and defining localities *"which have more interaction or connection with each other than with outside areas"* (Brown & Holmes, 1971, p. 57). This paper focuses on the multifaceted nature of the locality and as such includes the use of datasets that reflect social organisation, social ties and social interaction within the study area which are relevant for the purpose at hand, in this case, Primary Health Care Planning. Both flow data (reflecting population allegiance) and predefined boundaries (largely administrative), were collated and utilised in the analysis. Indeed, it is felt that flow data is the most important determinant of localities as it reflects the spatial interaction of individuals and local services. This spatial interaction highlights a population's allegiance to place and identifies spatially bounded functional localities. It is acknowledged that often times this data is difficult to collect and in health related research this has been seen as *"a substantial data collection roadblock"* (Erickson & Finkler, 1985). Previous research relying on theoretical catchments, hindered by data and technology restrictions, has highlighted the need for such an approach (Bullen et al., 1993 and Kivell et al., 1990).

Methodology

This paper focuses on how novel quantitative multidimensional geographical analysis was used to help facilitate the definition of primary care localities within a regional Health Authority (the Western Health and Social Services Board-WHSSB) in Northern Ireland. The WHSSB, provides health and social care services to a population of over 300,000 people. The area, typically rural and small town in character, has one medium-sized (c.100,000) urban centre, the city of Derry (Fig. 1).

In the context of a process of reorganisation in the delivery of primary care services, it was envisaged that new primary care localities would be created in the region with populations of between 50,000 and 150,000 that would *''hold the ring between collective needs of larger communities and the self-interests of small population based organisations''* (WHSSB, 1998, p. 29). A collaborative approach incorporating a geographical quantitative analysis of relevant secondary data sources conducted by academics in partnership with the Health Authorities planning team of professional practitioners and administrators was adopted. Both a 'constrained' and 'unconstrained' approach was employed (reflecting that of Bullen et al., 1993). The 'unconstrained' approach comprised the more objective academic analysis that was subsequently 'constrained' and adapted by the specific requirements and recommendations of the health authority (driven by local knowledge and administrative practicalities).

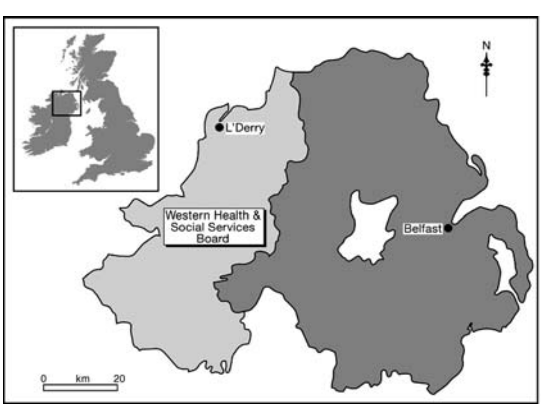

Fig. 1 Study Area

The remainder of this section and the results section present the methodology and outcome of the 'unconstrained' academic analysis. The final discussion section of the paper then describes how the academic analysis fed into and was adapted within the actual planning decision process (the 'constrained' approach).

The analytical framework

This analytical methodology is essentially based on the combination of two novel functional regionalisation techniques, the Synthetic Data Matrix (SDM) and the European Regionalisation Algorithm (ERA), both of which have been described in a previous paper by the authors and elsewhere (Coombes, 2000 and Shortt et al., 2005). In summary, it is a multidimensional approach that allows the researcher to combine numerous datasets, both flow and predefined, to define geographically bounded localities that reflect the underlying patterns of interaction and allegiance relevant and appropriate for their intended purpose.

Synthetic data matrix (SDM)

The Synthetic Data Matrix (SDM) is *'..a combination of boundary sets that allows the researcher to analyse multiple input boundaries and test the interconnectedness between the basic spatial input units, known as Building Block Zones (BBZs)'* (Shortt et al., 2005, p. 2718). The initial boundaries of each service for example, GP Catchments, were created by amalgamating contiguous groups of BBZs, in this case Enumeration Districts (EDs), based on the numbers and proportion of cases (patients) within each BBZ affiliated to each GP Surgery.

Each boundary set was analysed by comparing every BBZ with every other BBZ in the region to create a binary matrix that identified which pairs of BBZs were grouped in the same catchment for that service (= 1) and which pairs remained separate (= 0). The binary matrices for each service dataset in the analysis are then summed to create the composite Spatial Data Matrix (SDM). For example if only 2 boundary sets are to be included then the values will range from 0 (if a pair of

BBZs have been separate in each boundary set) to 2 (if a pair of BBZs have been together in each boundary set), this is demonstrated in Fig. 2. These SDMs provide us with evidence of the strength of association in order to define a range of optimal localities based on this level of spatial connectedness between areas.

The European regionalisation algorithm

The SDM is then analysed using the European Regionalisation Algorithm (see Coombes, 2000 and Shortt et al., 2005) which is a method of creating an 'optimal' group of non-overlapping macro regions according to a set of predefined selection criteria, namely, population size and levels of self containment thresholds. The self-containment threshold measures the degree of commonality between the BBZs across the total number of input datasets. For example, if a self-containment value of 50% is set then for two BBZs to be grouped in the final locality they must have been together in at least 50% of the input boundaries. This criteria ensures that the final regions display a strong degree of interconnectedness. Having the flexibility to vary the number of input datasets, the population thresholds and the levels of self containment as input parameter criteria in the ERA enables the analyst to test any number of different combinations and options for generating macro sub-regions within the study area. For the purposes of this paper, the results of three different options (described below) are presented as they were the final set of options considered by the Health Authority Planning Committee.

Matrix A

	A	B	C
A	-	0	1
B	0	-	0
C	1	0	-

+

Matrix B

	A	B	C
A	-	1	1
B	1	-	1
C	1	1	-

=

Sum Matrix

	A	B	C
A	-	1	2
B	1	-	1
C	2	1	-

Fig. 2 Creating a Matrix

Datasets

The choice of data in the definition of localities is subjective and dependent in many cases on data availability, and therefore open to scrutiny. It is recognised that any single dataset, representing a single locality function, will not accurately reflect a locality's internal structure compared to multiple datasets. Fortney (1997) recognised the problem associated with gathering such data stating that it '*lies in the dispersed nature of different sources across agencies and a perceived lack of ability to develop a joint approach to using it* [the data]'' (Fortney, 1997 in Naish et al., 1998 p. 8). The data employed in this study is divided into 3 sub-groups. These sub-groups represent particular forms of the social organisation of localities, namely, health care, administration, and education. For the 'flow' datasets that comprise information relating to individuals and the service they use (e.g. GP surgery or Primary School), unit postcode address information was required. The postcodes were geo-referenced and individuals allocated to their respective Census Enumeration Districts (our BBZs) using GIS techniques. This linking of individuals to BBZs facilitated the allocation of BBZs to service centres and thus the creation of flow-based catchment areas.

Health care

The creation of primary care General Practice (GP) boundaries has been outlined in detail in a previous paper and as such will not be discussed at length here (Shortt et al., 2005). The GP is an essential focal point of any locality and any study of the creation of localities for health care planning must reflect this. Having a GP-patient database, detailing the origin destination of every person registered with a GP, was considered to be essential within the study. The dataset used comprised of 300,197 persons and included their home postcode and the postcode of the GP practice at which they were registered. After geocoding, approximately 13% of the total records were removed due to either incomplete or missing postcodes (leaving 260,935 patients). This information enabled us to distinguish the origin-destination relationship and map the spatial interaction between the patients and each of the 31 GP practices in the area. The data was used to generate 8 variants of GP catchments that would then be used as individual inputs in the ERA analysis (Shortt et al., 2005). These variants, based on methodologies identified in the literature, were divided into three broad measures of regionalisation; patient origin, variable distance and geopolitical. The patient origin approach included percentage catchments (75% and 85%) and dominant practice catchments, derived from a calculation of a market share index for each practice. The variable distance measures included nearest feature analysis, nearest network analysis, mean distance catchments and perceived catchments of the GPs themselves. Finally the geo-political approach was taken as a radial measurement of 10 miles defined by the health board themselves.

Administration

Taket and Curtis (1989), implementing locality planning in East London, emphasise a ‘rational approach’ to data selection stressing that operational issues related to administration must be identified so that localities are realistic in management and planning terms. Four separate administrative datasets were used in this study, with the first reflecting the pre-defined boundaries of the District Council Areas (DCAs) (Local Authorities in Northern Ireland). The boundaries of the DCAs are frequently used for the aggregation and presentation of official statistics and as such provide officially recognised boundaries. These DCAs, of which there are 5 in the study area, represent the highest level of the administrative hierarchy in Northern Ireland. The second dataset within this sub-group represents local parish boundaries, which have previously been employed in locality studies (Bullen et al., 1993). Roman Catholic parish boundaries (of which there are 59) were used as they represent functional localities based on historic patterns of church attendance. Catholic parishes were employed, as opposed to any of the Protestant religious parishes, as it was deemed that they better reflect a sense of locality in the region (Mitchell, 1988). In Irish Catholic life, sports events, schools and community affairs are all organised around the parish structure.

The third boundary set in this sub-group represents policing areas of which there are 29 in the health board region. According to the police, these areas are based on workload and local knowledge held by the police force. It is therefore recognised that they represent an identifiable locality and, according to Kivell et al., (1990), bounded police areas are realistic and *“reflect the contemporary situation in the community”* (p. 706). The final administrative boundary dataset, job-centre catchments, represents economic focal points within large scale localities, similar to the local labour market areas used in previous locality studies (Coombes and Openshaw, 2001). Journeys to job-centre flows express the willingness of people to travel in search of employment, and generally serve extensive geographical catchments. The dataset gathered in relation to these offices represents the flow, over a one year period, between all jobseeker’s ($N = 4{,}969$) and the job-centre office ($N = 5$) they attended. BBZs were allocated to 1 of the 5 offices depending on the registrations of the majority of job seekers in each through the calculation of a relevance index (Griffith, Restuccia, Tedeschi, Wilson, & Zuckerman, 1981) to create catchments which can be considered as proxy indicators of local labour markets.

Education

Schools, most notably primary schools, operate within very local markets and as such provide focal points for localities. Recent reforms in the education system have granted parents freedom of choice thus limiting the spatial significance of pre-defined catchments, with allegiances now reflecting daily population interactions (Bradford, 1991; Clarke and Langley, 1996 and Gibson and Asthana, 2000). The spatial implication of this catchment permeability is that many pupils now flow across previously defined boundaries. Examining the functional units through which primary education is delivered provides the smallest scale of areal units available, whilst the inclusion of secondary school catchments creates a hierarchy representing the geography of education within the study area.

Although it is highly probable that children will attend their nearest school, such an assumption cannot be made and, as such, catchments based on origin-destination data are required. In Northern Ireland this problem is further compounded by religious segregation in the education market, with the religious affiliation of each school determining the extent of the school's catchment. For primary school catchments a dataset reflecting the enrolment and addresses of all pupils of transfer age (11 Year Olds) was gathered (N = 4,615) along with a further dataset including the address, postcode and religious denomination of each primary school (Catholic = 122, Protestant = 71, Integrated = 3). Data at such a finite level is of considerable interest and allows one to examine the nature of flows between pupils and primary schools in both the Catholic and Protestant education market. Catchments of primary schools, reflecting very local areas, were created through the analysis of this detailed dataset (Shortt, 2002 and Shortt and Moore, in preparation). In a second stage analysis, secondary school catchments were created based on the initial primary school areas and transfer criteria. There are 51 secondary schools in the study area, each falling within one of four categories (Table 1). Protestant secondary schools admit students on the basis of feeder schools, being named primary schools which essentially "feed" into secondary schools (normally 4 or 5 feeder primary schools per secondary school). Catholic schools, on the other hand, select their pupils on a parish basis (normally between 3 and 5 parishes per secondary school). As such secondary catchments were created for each school type based on the amalgamation of either protestant primary school or catholic parish boundaries.

ERA model options

Many different combinations of input datasets were tested using the ERA (Table 2). In the end, three main model options were presented to the Health Authority for consideration and are described in the results section. The first option included all 16 boundary sets reflected both population movements within localities and predefined administrative boundaries. Option 2, was a pure primary care approach as it used a SDM that included all 8 separate GP regionalisations. The third option also used GP data but this time used the GP catchments as the BBZs as opposed to Enumeration Districts. In doing so we were creating a three level hierarchy of health care with the patients nesting within the EDs, the EDs within the GP catchments and the GP catchments within the final localities. Finally, optimising the boundaries of options 2 and 3 using overlay techniques and welcoming input from the health board allowed us to define localities that incorporate features of both rigorous spatial analysis and a wealth of local knowledge through discussion and debate.

Results

Clearly the population and self-containment thresholds of the ERA are critical and their replication between each of the options is essential to allow for overall comparability between the localities. Indeed according to Openshaw and Alvanides (2001) the best approach is to *"identify suitable zone design functions and constraints, thought to be best for particular purposes and then to be able to compare and evaluate different zonations of the same dataset"* (p. 289). Although setting the parameters is a subjective process, their limits should reflect the phenomenon studied and the nature of the observed data and in this phase of the analysis various parameter groupings were explored, whilst considering the requirements of the final localities in terms of population

Table 1 Schools by type

School type	Number	Religion
Controlled	15	Protestant
Grammar	4	Protestant
Secondary	11	Protestant
Maintained	24	Catholic
Voluntary grammar	9	Catholic & Protestant
	2	Protestant
	7	Catholic
Grant maintained	3	Integrated

Table 2 Options used in the ERA

Option 1	Option 2	Option 3
District council areas (*pre-defined*)	75% GP catchments (*flow-based*)	Optimal GP catchments
Catholic Parishes (*pre-defined*)	85% GP catchments (*flow-based*)	
Policing areas (*pre-defined*)	Dominant practice GP catchments (*flow-based*)	
Job centre areas (*flow based*)	Nearest feature GP catchments (*flow-based*)	
Protestant primary schools (*flow based*)	Nearest Network GP Catchments (*Flow-Based*)	
Catholic primary schools (*flow based*)	Central service agency GP catchments (*flow-based*)	
Protestant secondary schools (*flow based*)	Perceived GP catchments (*pre-defined*)	
Catholic secondary schools (*pre-defined*)		
75% GP catchments (*flow-based*)		
85% GP catchments (*flow-based*)		
Dominant practice GP catchments (*flow-based*)		
Nearest feature GP catchments (*flow-based*)		
Nearest network GP catchments (*flow-based*)		
Central service agency GP catchments (*flow-based*)		
Perceived GP catchments (*pre-defined*)		

size and ultimate functions of health care delivery and management. Table 3 displays the two parameter sets that have been used. By means of explanation it is clear that for a locality to emerge from parameter set 1 it must have a population above 40,000 and a self-containment value of at least 5%. Although the self-containment value appears low, it should be noted that all final localities had much higher levels.

Using all 16 boundaries from each of the 3 data sub-groups in option 1, localities were defined that represent three main functions of daily life: administration, education and health care. The importance of flow data within this option is emphasised and in this case it is represented through all 3 functions. Coombes (2000) weighted his one flow dataset (journey to bank flows) as essentially four times more important than the fixed boundaries by adding it to the SDM four times. Although each of the data sub-groups are included in this option, it is noted that the health care data is essentially ‘weighted’ as twice as important as it contains 8 boundary sets of the same data compared with 4 in education and administration. The justification for this lies in the nature of the final localities being

Table 3 Parameter sets 1 and 2

Parameters	Target population	Minimum population	Target Self-Containment	Minimum self-containment
Parameter set 1	80,000	40,000	25%	5%
Parameter set 2	75,000	25,000	90%	20%

required for health care purposes, as such it is reasonable to suggest that the health care boundaries should have a greater degree of influence.

Applying parameter set 1 to this option has created 6 localities centred around the main population hubs (Fig. 3a). The populations of these localities range from 32,668 to 55,930 (the population figures on the maps refer to the patient population described earlier). This output was felt to be unsuitable for the purpose at hand as the areas are too small for devolved commissioning. In contrast applying parameter set 2 has resulted in the creation of 4 localities (Fig. 3b). What is interesting here is the apparent dominance of the smaller boundary sets, seen through the division of Derry City. Although the river Foyle, as a natural boundary, has traditionally divided this city, this division is also based on the religious persuasion of the residents with Protestants residing on the waterside (east bank) and Catholics on the city side (west bank). In the smaller boundary sets of administration, as well as health care and education, the city has been repeatedly divided emphasising the rigid nature of the natural (and unnatural) divide.

Option 2 applies the ERA to the SDM of the 8 GP regionalisations. In this case parameter set 1 was applied but once again rejected as 7 largely fragmented localities were created (Fig. 4a). In contrast parameter set 2 created 3 localities with populations ranging from 58,199 to 116,717 (Fig. 4b). Although self-containment levels were set at a minimum of 5%, all 3 areas have passed the 25% target value. On this occasion a completely separate region has been created for Derry City, dissolving the internal division in previous outputs. This stressed the role that the very local school catchments, which emphasise religious division, may have played in the persistence of this result in the previous option.

In a form of second stage processing, the ‘optimal’ GP catchments identified by Shortt et al. (2005) now replace the EDs as BBZs in option 3. Although the ERA will analyse the same data as that used in option 2, on this occasion there is a constraint against splitting any of the 30 optimal GP catchments, and in doing so these are now used as the BBZs. Applying this constraint will result in a hierarchical grouping whereby the EDs nest within the optimal GP catchments, and the GP catchments nest within the localities defined here. Although this reaggregation of these catchments is seen as suitable for this purpose in providing a logical health care hierarchy, it is recognised that this would be suboptimal for other analyses.

Parameter set 1 is not applied here, as it consistently failed to produce localities of an adequate population size. 3 localities are once again

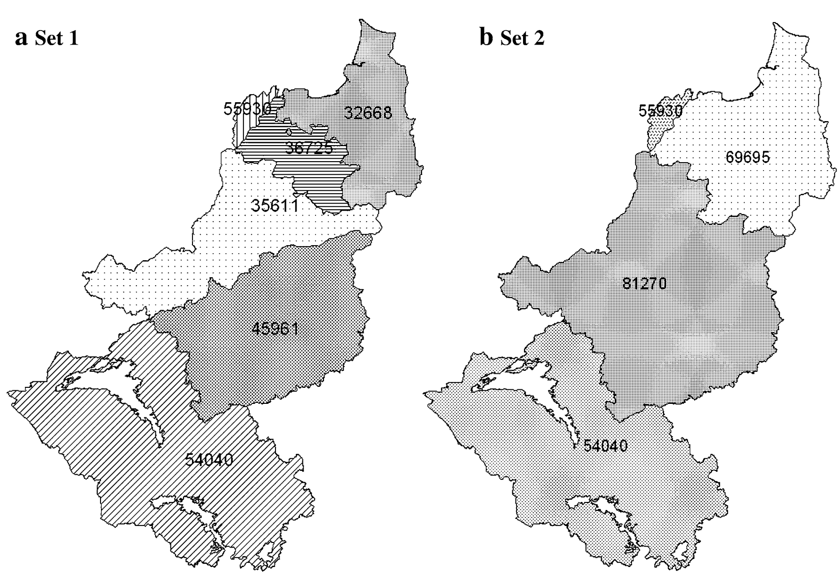

Fig. 3 Option 1 Parameter Sets 1 and 2

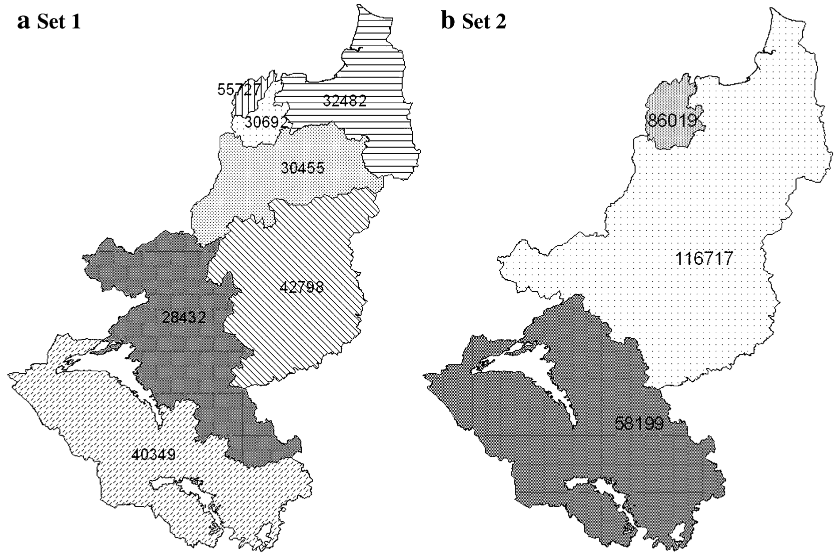

Fig. 4 Option 2 Parameter Sets 1 and 2

created using parameter set 2, but the pattern is considerably different from the previous option exemplified by a large increase in the Derry locality (Fig. 5). Although the geographical extent and number of GP catchments within each locality is reasonably consistent, the populations vary considerably from 54,793 and 57,085 in the southern and mid localities respectively to 149,057 in the northern locality. The benefit of this hierarchical structure is noted in terms of resource planning and needs assessment; as such each locality can be divided at a more local level into the respective number of optimal GP catchments.

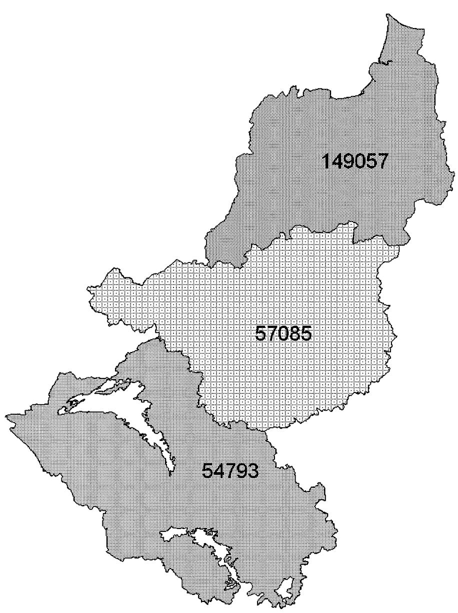

Fig. 5 Option 3 Parameter Set 2

Consultation and discussion

The localities created for each option were presented to the members of the Health Information Unit (HIU) within the board ensuring that the final decision would be informed and practical. This approach reflects previous work in this area (Taket & Curtis, 1989; Bullen et al., 1993) and it is acknowledged in the literature that such applied critical appraisal of academic work propels any research into an applied dimension. According to Coleman (1980) such *'knowledge of policy alternatives and options would make for more rational and ordered decisions'* (Coleman, 1980 in Clark, 1982, p. 50) on behalf of such organisations.

Considering the options and the data groups employed in each, members of the group felt that option 1 lacked a specific health care focus. It was recognised that such an approach would be sensible when trying to reflect the everyday lives of the population, but the health professionals were keen to place more emphasis upon the health care

Table 4 Final ERA parameters–parameter set 3

Option	Target population	Minimum population	Target self-containment	Minimum self-containment
Final option	100,000	75,000	100%	5%

boundaries and as such requested further analysis of options 2 and 3. It was proposed that any further analysis should create localities of larger populations and as such the parameters of the ERA were adjusted to reflect this. Parameter set 3 was devised by adjusting the population levels (Table 4) and it was found that by raising the parameters any further the ERA failed to produce any division of the health board. Indeed, as was evident in the previous outputs it is the population parameters that have the greatest degree of influence in the resulting localities.

Applying parameter set 3 to option 2 resulted in 2 localities of similar populations, a northern locality of 130,359 and a Southern locality of 130,576 (Fig. 6a). What was interesting about this result it that it stands in stark contrast to the majority of other outputs and indeed board members with considerable local knowledge felt that the commuting towns south of Derry should be included in the Northern locality as distinct satellite towns of the more urban centre. In contrast, applying the same parameters to option 3 produced entirely different results, with Derry City and the rural hinterland on this occasion creating a separate locality thus reflecting popular belief that these commuting towns are inextricably linked (Fig. 6b). The results from both of these options would appear to confirm that the 'usual' rule applies in that much more appropriate boundaries are created from an analysis of much smaller building blocks.

Further reporting to the HIU and the health board council resulted in a shared response stating that neither of these two options truly reflected the Board's needs. It was felt that a key requirement would be the ability to subdivide the localities according to the optimal GP catchments to aid future planning of service delivery but that the results of option 3 did not accurately reflect the boundaries created by outputs of the earlier trials. Further meetings with key stakeholders led to a strong consensus that an optimisation of the final 2 options would provide realistic localities that could be divided according to the GP catchments. Indeed, the propensity to form areas based on the conscious optimisation of the outputs to obtain a specific result further highlights the adaptability and applied relevance of the methodology. Such a process is indeed

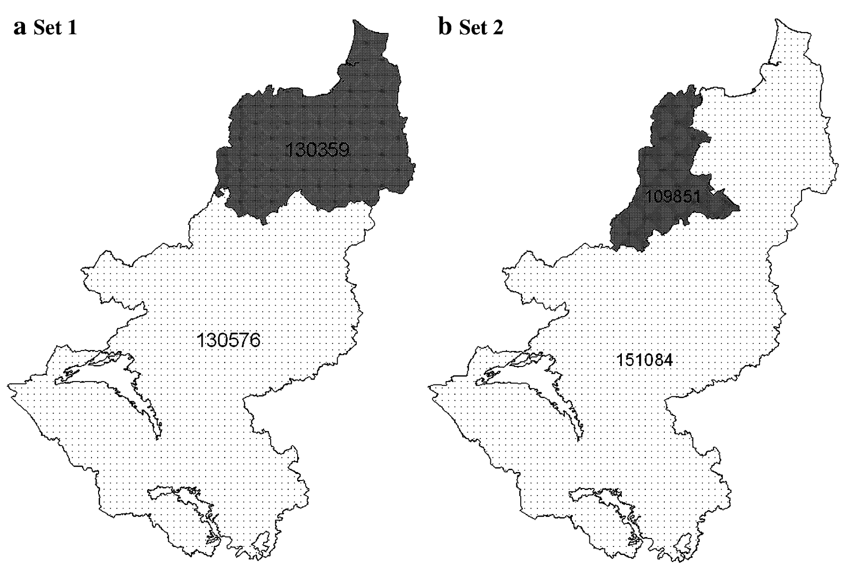

Fig. 6 Parameter Set 3 applied to Options 2 and 3

recommended by Openshaw and Alvanides (2001) who state that *"the only alternative to 'as is' spatial representation is to develop zone design as a spatial engineering tool to provide a platform for controlled visualisation, visual spatial analysis and even deliberate spatial distortion to serve a particular purpose"* (p. 285). Although boundaries drawn by the health care planners themselves were not included in the model (with the exception of perceived GP catchments), their personal input at the consultation stage ensured their direct involvement and participation in the final phase. Overlaying the boundaries of Fig. 6a and b and joining the southernmost boundaries (following the lower tier of GP catchments) created a new set of localities (Fig. 7). This constrained approach reflects the results previously noted in the outputs of all options using parameter sets 1 and 2 and that resulting from the more locality driven approach of option 1.

The final set of localities that resulted from the constrained approach represents a user-defined geography incorporating features of both rigorous spatial analysis and a wealth of local knowledge through discussion and debate. Whilst it is recognised that the entire process is only a proxy for locality definition, and as a whole the notion of social cohesion is difficult to measure, it is also felt that the methodology reflects the level of interaction between the areas and as such the localities defined represent a sense of similarity within them and separateness between them. It is noted that the initial set of localities resulting from the ERA are not fundamentally superior to those created through the user defined approach. Instead the compromise based on local knowledge of the regions characteristics results in localities that are consistent in terms of GP populations whilst providing meaningful geographic regions. The localities that were finally implemented by the health board are those that evolved through rigorous application of parameters in detailed analysis and intense scrutiny from health care professionals.

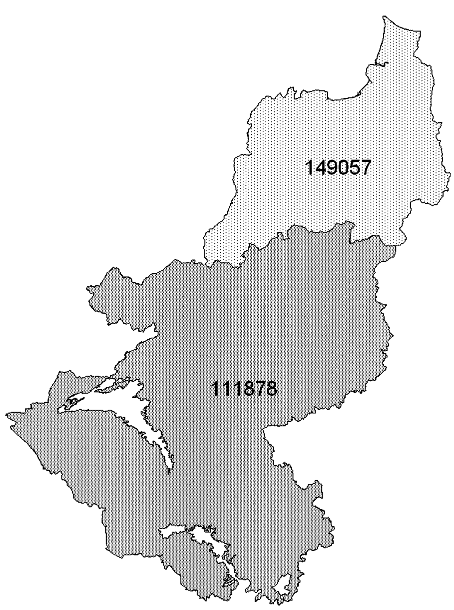

Fig. 7 Final Constrained Localities

The major benefit of the localities created through each option lies in the consistent approach applied in their definition. This level of consistency enables comparability between the localities for any form of health care planning. With respect to the spatial extent of the health care hierarchy in the health board it is felt that the final localities encompass too large an area for detailed locality planning as such large-scale spatial units mask internal variations whilst analysis at the BBZ level would be too detailed and time consuming. The ability to 'drill down' in the hierarchy to the 'optimal' GP catchments provides an appropriate layer defined from both population flows and a policy perspective. At the higher end of the hierarchy the localities represent the decentralising of power to a more local level and a shift from the 'top down' to 'bottom up' approach to health care delivery. This ability to deconstruct the localities via the 'optimal' GP catchments displays a balance between the Micro and Macro government policies.

The final localities, whilst not based upon the approach employing all 3 data sub-groups, do reflect local knowledge thus emphasising the importance of a sense of daily interaction in these constructs. Although the health care professionals felt that the data included in option 1 would not create appropriate localities for health care planning, the applied approach of consultation and manual adjustment of the boundaries reflects on the ground knowledge of spatial allegiance and the results of the analysis using the locality approach (option 1). This means of addressing the challenging practical definition of these sociological constructs emphasises the importance of collaboration between the health service professionals and academics in any work of this nature. We have combined insights from the professionals with the results of a complex regionalisation process, thus gleaning knowledge from them whilst translating the results of the ERA into practical localities for health care delivery. This approach can be seen to incorporate two views of space, the socio-spatial and geometric space (Kearns & Joseph, 1993), through the inclusion of personal perceptions and applied spatial analysis of patterns and processes. According to Kearns and Joseph (1993) this approach ''emphasises the interdependence of place and space'' (p. 712) whilst also mirroring the idea of ''constrained'' and ''unconstrained'' outputs as discussed by Bullen et al. (1993). Clearly this dual pronged approach reflects the importance for professionals and administrative groups of the data reflecting the purpose of the localities, with local knowledge adding the ''locality'' perspective as opposed to data reflecting the daily interactions of the population. We are not saying that an approach to defining localities based on multiple representations of place is inappropriate, indeed we reaffirm the belief that a single dataset will not accurately reflect a locality's internal structure, but the process and final boundaries should reflect their purpose, in this case health care planning. Although the final localities are limited in their general applicability, for the purpose of health care planning they provide a robust, consistently defined hierarchy of health care areas. As the localities were created for a specific purpose they are entirely appropriate as a simplification of a much more complex underlying social structure.

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